

ABSTRACT

A current-controlling device comprising a first conductor, a second conductor, and a tunneling barrier comprising a first insulating layer between the first conductor and the second conductor. The tunneling barrier electrically isolates the first conductor from the second conductor. At least one mobile charge is positionable within the tunneling barrier. The device also includes a gate, wherein a voltage applied to the gate with respect to the substrate (or with respect to a second gate formed on or in the substrate) modulates or moves the mobile charge to a position between the first conductor and the second conductor within the tunneling barrier, thus deforming the shape of the energy barrier between the first conductor and the second conductor. The deformation can cause a current to flow between the conductors when a voltage is present between them due to quantum mechanical tunneling.